ATTACHMENT J.4.93

CALCULATION PREPARATION AND REVIEW PROCESS

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SITE PROCEDURE ED-12-4005
REVISION NO. 1

CALCULATION PREPARATION AND REVIEW PROCESS

ED-12-4005

Effective Date: August 15, 1997

Originator (Subject Expert): F. T. Jebens — Date: 8/11/97

Checker Concurrence: W. E. Kortier — Date: 8/11/97

APPROVED BY: A. C. Noble, FAM
Engineering Design — Date: 8/11/97

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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RECORD OF ISSUE/REVISIONS

DATE	REV. NO	DESCRIPTION AND AUTHORITY
11/15/93	A	New procedure to instruct engineers how to prepare calculations per Request No. S93-093 initiated by Tom Rich.
09/06/94	0	Revised document. Changes initiated by Ron Worsley.
08/15/97	1	Revised document to reflect re-engineered Fluor Daniel Fernald.(FDF) organizational changes. Initiated by G. C. Olbur.

1.0 PURPOSE

This procedure provides instruction for preparation, checking/verification, approval and control of calculations used for design analysis and verification.

2.0 SCOPE

This procedure applies to Fluor Daniel Fernald, (FDF) Engineering Design personnel and to external subcontracted design organizations (where established by contract) involved in the preparation, review, and revision of calculations for all engineering disciplines.

3.0 REFERENCES

As required by contract and Standards/Requirements Identification Documents.

4.0 RESPONSIBILITIES

Discipline Engineer - Implements this procedure, approves calculations, maintains a log of design calculations, and ensures the approved calculations are filed for future retrieval. Prepares the assigned calculation, or required revisions thereto, and supports the checking/approval process.

Independent Reviewer - performs an independent review of applicable calculations and independently verifies the technical accuracy of calculations.

5.0 GENERAL

5.1 This procedure meets the requirements for design control per RM-0012.

5.2 Although the type and extent of calculations is very dependent upon the engineering discipline and the item being considered in the calculations, all calculations have certain minimum requirements with respect to content, assumptions, references, and computer analysis provided in this procedure.

6.0 PREREQUISITES

None

7.0 PROCEDURE

7.1 DETERMINING IF A CALCULATION IS NEEDED

DISCIPLINE ENGINEER

1. Conduct research to determine if previous calculations exist for similar activities.

***Note*: Calculations that were previously prepared/validated or code-approved data/values for similar activities may be utilized in place of a new calculation.**

2. If a previous calculation is used, prepare a memo justifying the validity of the calculation and file as a permanent project record.

3. If a calculation does not exist, establish the calculations needed for the project based on the project design criteria document and assign an engineer to prepare the calculation.

7.2 PREPARING CALCULATION

DISCIPLINE ENGINEER

1. Generate calculations on a Calculation Sheet.

2. If signatures and seal of a registered professional engineer is required by local and state laws and regulations, or if required by the contract, prepare a title page (see Figure 1) for major calculations.

3. Assign an identification number to the calculation in accordance with Engineering/Construction Document Control procedures.

***Note*: The identification number includes the discipline identification, project number, and a sequence number.**

4. If computer programs are used, attach the input and output listings to the calculation, along with the engineer's analysis of the results.

***Note*: The computer program name, number, version, run date and calculation number will appear on each page of the program output. Only validated and verified computer programs will be used.**

5. Initial and date each page of the calculation.

7.3 CHECKING CALCULATION (i.e., Independent Reviewer, per ED-12-4010)

INDEPENDENT REVIEWER

1. Perform step 2 or 3 (optional) of 7.3 to check the calculation and then proceed to step 4 of Section 7.3 of this procedure.

2. Check all calculations to verify the following, as applicable:

   a. Were the design inputs correctly selected?

   b. Are assumptions necessary to perform the design activity adequately described and reasonable? Where necessary, are the assumptions identified for subsequent reverifications when the detailed design activities are complete?

   c. Was an appropriate design method used?

   d. Were the design inputs correctly incorporated into the design?

   e. Is the design output reasonable when compared to design inputs?

   f. Are the necessary design input and verification requirements for interfacing organization specified in the design documents or in supporting procedures or instructions?

   g. Assumptions used to originate or revise a calculation shall be identified within the calculation. Assumptions to be verified as the design progresses shall also indicate that verification is necessary.

Note*: *Independent reviewers shall not have participated in establishing design concepts or inputs for the items being verified. Exceptions to this limitation are restricted to situations where the only qualified individual available to perform the independent review does not meet the independence rule requirements. Justification for such exceptions are documented and signed by the Discipline Engineer, per ASME NQA-1.

3. Verify the design by use of alternate calculations, or by performance of qualification tests as follows:

   a. Alternate Calculations:

      1) Repeat independently the calculation employing either an identical technique, a different technique, or an approximate technique, as appropriate.

7.3 CHECKING CALCULATION (i.e., Independent Reviewer, per ED-12-4010)

2) Verify the appropriateness of assumption, input data, and the computer program used or by other calculation method.

b. Qualifications Test:

1) Perform qualification testing of a design under the applicable design conditions by either a prototype or production unit.

2) Where design adequacy is to be verified by testing, identify the test and clearly define and document the test configuration.

DISCIPLINE ENGINEER

4. Verify changes resulting from the review process and incorporate valid changes into the original calculations.

INDEPENDENT REVIEWER

5. Check corrected calculations to ensure that all corrections have been made.

a. If agreement cannot be reached between the Checker and the Discipline Engineer, consult the Facility/Technical Engineering Team Coach for resolution.

b. When agreement is reached to approve, initial and date each page of the final calculations.

c. Forward approved calculations to Discipline Engineer.

DISCIPLINE ENGINEER

6. Review calculations to ensure that proper review has been performed and that all calculations are reviewed and checked by the Discipline Engineer. Refer to Table 1 for signature and approval requirements.

7. Maintain calculation records as permanent project records.

***Note**: These records are sent to Engineering/Construction Document Control for retention after project close-out in accordance with the engineering design activity close-out procedure ED-12-8001.*

7.4 REVISING APPROVED CALCULATIONS

DISCIPLINE ENGINEER

1. Assign calculations to the Discipline Engineer or his equivalent for revision whenever a change to the design affects the calculations.

***Note**: Calculations always reflect the current status of design.*

2. Revise calculation in accordance with Table 2.

INDEPENDENT REVIEWER AND DISCIPLINE ENGINEER

3. Review and file revised calculation in accordance with Section 7.3 of this procedure.

8.0 RECORDS

8.1 All correspondence directing action will be processed in accordance with (IAW), site procedure ED-12-5001, "Engineering /Construction Document Control".

9.0 DRIVERS

9.1 RM-0016, "Management Plan"

9.2 RM-0012, "Quality Assurance Program"

10.0 DEFINITIONS

Checker - An individual, other than the cognizant engineer and designated by the section supervisor, who performs the checking of the calculation to insure technical accuracy of the engineering analyses.

Checking/Verification - The process of reviewing, confirming, or substantiating the design by one or more methods to provide assurance that the design meets the specific design criteria. Verification includes, but is not limited to, checking for applicability of design inputs for completeness, clarity, and accuracy of the calculations/analysis.

Design Inputs - Those criteria, parameters, bases, engineering judgements and assumptions, or other design considerations upon which the final design or design of a modification to a structure, system, or components is based.

10.0 **DEFINITIONS** (cont.)

Engineering Calculations/Analysis - Those documents which show the computations and/or analysis of data and provide the supporting design and safety information (design inputs).

Originating/Project Engineer - The individual assigned responsibility for performing and documenting a design activity in an engineering analysis.

Discipline Engineer - The engineer within each discipline assigned responsibility for managing that discipline's activities on the project.

TITLE PAGE

Total No. of Pages: _____

DEPARTMENT: _____ **ORIGINATED BY:** _____ **DATE:** _____

CALCULATION NO. _____ **CHECKED BY:** _____ **DATE:** _____

AREA: _____ **REVISED BY:** _____ **DATE:** _____

PROJECT NO.: _____ **APPROVED BY:** _____ **DATE:** _____
(Discipline Engineer)

_____ **DATE:** _____

SUBJECT: _____

RECORD OF REVISIONS

NO.	REASON FOR REVISION	DATE	ORIG.	INDEPENDENT REVIEWER	APPROVER

REGISTRATION STAMP
(AS APPLICABLE)

SIGNATURE: _____

NUMBER: _____

Figure 1 – Example of Calculation Title Page

TABLE 1
SIGNATURES AND APPROVAL

1. The Calculation Title Page is signed and dated by the individual(s) originating the calculation. If the individual originating the calculation is unavailable, the immediate supervisor may sign the certification page
2. Following completion of checking and resolution of Checker's comments in the calculation, the Calculation Title Page is signed and dated by the Checker.
3 All pages after the Calculation Title Page, except numbered appendices, shall include the name or initials and date of the Originator and the Checker.
4 The checked calculation is then reviewed and approved by the Discipline Engineer as follows: 4.1 As a minimum, reviewing the design inputs, concept, design method, and conformance with applicable codes and standards. Discrepancies, if any, are resolved with the Originator and the checking step repeated. 4.2 Signing and dating in the "Approved By" blank on the Calculation Title Page.
5. Calculations are certified as above prior to the release of the calculation, its results, or any documents (i.e., specifications, drawings) for construction or fabrication based on the calculations. When it is necessary to release part of the item design for construction or fabrication before the calculation is completed, only the applicable portion of the calculation must be certified as if it were a complete calculation. As subsequent portions are finished, they are to be certified as a revision.

TABLE 2
REVISION REQUIREMENTS

1. Initial issue of a calculation is denoted as Revision 0. Each subsequent revision is given a sequential number starting at one. The revision number appears on each revised page. The Record of Revision clearly indicates the revision number, and other required information on the Calculation Page Sheet.

2. Revisions are noted by a revision number in a delta (e.g., $\overset{1}{\triangle}$ for Revision 1 change) next to each change. If the revision creates change throughout a page, a single delta in the upper portion of the calculation sheet is used.

3. Pages are not renumbered. New pages are given lower case alpha characters as a suffix to the page they follow; e.g., 15a would follow page 15. Total number of pages is reflected on the Title Page.

4. Minor Revisions - When revisions require minor changes to the existing calculation, these changes may be made on the existing pages. However, these changes must meet the following criteria:

   4.1 There must be enough room on the page to allow clear presentation of the change and required information.

   4.2 A voided calculation must be clearly deleted by lining through deleted information, but not obliterated.

   4.3 A revised computation must be near to and clearly indicate the computation it replaces.

   4.4 A revised computation must be initialed by the person performing the computation or his equivalent, be dated, and clearly indicate the revision number.

5. Revision, deletion, or addition of pages is indicated in the Record of Revision, listing the pages and the associated volume.

6. Revision, deletion, or addition of attachments is indicated in the Record of Revision by listing the attachment number and the associated volume.

7. Deletion or addition of volumes is indicated in the Record of Revision by listing the volume number.

8. A statement documenting the reason for any revision and a brief written description of the changes is noted in the Record of Revision. If additional space is required, the Record of Revision-Continuation is added to the calculation immediately following the Calculation Title Page and number (1a, 1b, etc.).

9. When a calculation is revised, all other documents affected by the revision are appropriately revised in a timely manner.

10. Revisions are reviewed and approved by the same individual (or their equivalent) who approved the original calculations. Approvals are indicated by dated initials in the Record of Revision section of the Calculation Title Page.